2007-00932

RESEARCH HIGHLIGHTS

Technical Series 01-101

GREENBACKS FROM GREEN ROOFS: FORGING A NEW INDUSTRY IN CANADA

Introduction

Finding practical and effective ways to implement sustainable development remains a significant challenge in Canada. One approach involves using green roof and vertical garden technologies on residential, institutional, industrial and commercial buildings. These technologies address a number of economic and environmental challenges facing Canadian cities. They provide such benefits as better air quality, reduced greenhouse gas emissions, improved stormwater management and long-term economic advantages, plus social benefits.

Green roof installations are different from freestanding planters in that they are applied as part of the roofing system. This green roof technology includes the following components:

- roof structure, and possibly some insulation
- waterproofing membrane, often with root repellent insertion
- drainage system, sometimes with built-in water reservoirs
- landscape or filter cloth to contain the roots and the soil
- specialized growing medium
- plants.

The barrier between the plants and any roof penetrations, parapet walls or flashing is crucial to prevent roof penetration and allow excess water to run off the roof.

There are basically two types of green roof systems: extensive and intensive. Extensive green roofs are characterized by their low weight, low capital cost and minimal maintenance. Intensive green roofs have a greater soil depth and more plantings with higher maintenance requirements. Further differences between the two systems are outlined in Figure 1.

A vertical garden is essentially a living cladding system with many of the benefits of a green roof. With these gardens, plants grow on, up or against a building's façade. Suitable plants include a wide variety of perennial and annual vines as well as espaliered trees. Vertical greening has more potential impact, with greening of a building's façade often encompassing four times the area of the roof and even more for a highrise building.

Green roofs and vertical gardens are a well-established feature in many European countries, with policy makers having put in place various measures to support the application of these technologies. This has resulted, for example, in 10 million square metres of green roofs being developed in Germany alone in 1996. While these technologies are not totally unfamiliar in Canada, they are used only to a very limited extent.

Canada Mortgage and Housing Corporation funded research, with in-kind support from Environment Canada, to gain a better understanding of the benefits of green roofs and vertical garden technologies and barriers that prevent more widespread adoption in Canada.

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Figure 1. Comparison of Extensive and Intensive Green Roof Systems

Extensive Green Roof	Intensive Green Roof
• thin soil, little or not irrigation, stressful conditions for plants	• deep soil, irrigation system, more favorable conditions for plants
Advantages: • lightweight - roof generally does not require strengthening • suitable for large areas • suitable for roofs with 0-30° (slope) • low maintenance • often no need for irrigation and drainage systems • relatively little technical expertise needed • often suitable for retrofit projects • can leave vegetation to develop spontaneously • relatively inexpensive • looks more natural • easier for planning authority to demand green roof as a condition of planning approvals	**Advantages**: • allows greater diversity of plants and habitats • good insulation properties • can simulate a wildlife garden on the ground; can be made very attractive; visually often accessible, with more diverse utilization of the roof i.e. for recreation, growing food, as open space.
Disadvantages: • more limited choice of plants • usually no access for recreation or use • unattractive to some, especially in winter	**Disadvantages:** • greater weight loading on roof • need for irrigation and drainage systems (greater need for energy, water, materials, etc) • higher cost • more complex systems and expertise required

Source : Johnston, 1996, p. 54

Research Objectives and Methodology

The research had four objectives:

- Review the status, quantitative and qualitative benefits and opportunities associated with green roof and vertical garden technologies.
- Identify barriers to more rapid implementation of these technologies in Canada.
- Engage a variety of public and private stakeholders in a workshop to familiarize them with the concept and benefits of this form of greening, and obtain their input.
- Develop recommendations to overcome the most significant barriers to adopting these technologies in Canada.

The research included a literature review, interviews with 10 individuals involved in green roof and vertical garden projects in Canada and a workshop with industry and government representatives. An advisory team provided strategic advice and technical information.

Benefits

Green roof and vertical garden technologies offer a wide range of public-private, environmental, economic, and social benefits. Finding new ways of using roof and wall space can generate added economic impetus and make cities more liveable by providing significant amounts of accessible outdoor recreation or amenity space close to work and home.

Vertical gardens block movement of dust, while green roofs have a moderating effect on thermal air movement and trap airborne particulates. Studies have shown that treed urban streets have substantially less dust compared to those without trees. Both green roofs and vertical gardens further contribute to reducing pollution by absorbing gaseous pollutants.

These systems have a beneficial impact on moderating the heat gain and loss of buildings, as well as on humidity, air quality and reflected heat. In conjunction with other green installations, these technologies can play a role in altering the climate of a city as a whole. A German source remarked that a healthy urban climate could be achieved by greening only 5% of all roofs and walls within a city.

Widely implemented, these technologies can provide effective methods for reducing greenhouse gas emissions by shading buildings, improving insulation values and reducing higher urban temperatures caused by the expanse of reflective surfaces in urban areas, known as the "Urban Heat Island Effect". Higher temperatures increase atmospheric instability, which in turn can increase the chance of rainfall and severe thunderstorms. They also affect air quality, as heated air stirs up dust. Strategically placed vertical gardens can help cool air and slow it down, by creating turbulence in vertical air flow.

Another significant benefit of green roofs is their ability to retain stormwater. Typical stormwater systems in urban areas have resulted in a number of problems, such as water contamination, sewage overflows, drops in local water tables, water temperature increases, severe flooding and erosion. Green roofs and vertical gardens provide viable alternatives for environmentally appropriate stormwater management. Studies in Berlin show that green roofs absorb 75% of the precipitation that falls on them. Runoff occurs over several hours, thereby reducing the risk of sewage overflows and flash floods.

There are economic cost benefits for building owners. The green roof and vertical garden systems provide energy cost savings due to increased insulation, extend the life span of roof membranes and vertical surfaces due to improved protection, provide sound insulation, increase aesthetic appeal and, potentially, improve property values. Green roofs protect roofing membranes against ultraviolet radiation, extreme temperature fluctuations and puncture or physical damage from recreation or maintenance. Vertical gardens likewise provide protection from ultraviolet radiation, driving rain and wear and tear caused by moisture and temperature differentials. They also decrease the effect of wind pressure, which can improve the airtightness of doors, windows and cladding. Green roofs can be used for other advantages, such as recycling wastewater and in water-based heat exchange systems.

Recommendations

The research project identified a number of steps to overcome barriers to greater diffusion of green roof and vertical garden technologies in Canada. The major types of barriers identified were a lack of knowledge and awareness of the systems and associated cost benefits, a lack of incentives to facilitate implementation, a lack of specialized products, few Canadian installations and no technical standards. The following steps were recommended to overcome these barriers:

1. Address knowledge and awareness limitations by compiling a repository of green roof and vertical garden knowledge on the Internet, and promoting its availability.
2. Generate awareness through high-profile demonstration projects, such as design and implementation competitions in major cities across Canada.
3. All levels of government should actively support green roof and vertical garden technologies, by introducing relevant procurement policies, implementing aggressive plans for installations and making it mandatory to include these technologies in new buildings.
4. Introduce grants or indirect subsidies to reduce payback periods and associated economic uncertainties to encourage private owner installations.
5. Encourage insurance companies to investigate benefits that would reduce premiums, such as increased building envelope life span and energy efficiency, and facilitate performance-based contracting installation through industry-government partnerships.
6. Reduce technical issues and uncertainty by providing financial support for increased research and creating high standards for both retrofitted and new installations.

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